1997. The Journal of Arachnology 25:20–30

BEHAVIOR AND NICHE SELECTION BY MAILBOX SPIDERS

Robert L. Edwards[1] and **Eric H. Edwards**[2]: [1]Box 505, Woods Hole, Massachusetts 02543 USA and [2]45 Canterbury Lane, East Falmouth, Massachusetts 02536 USA

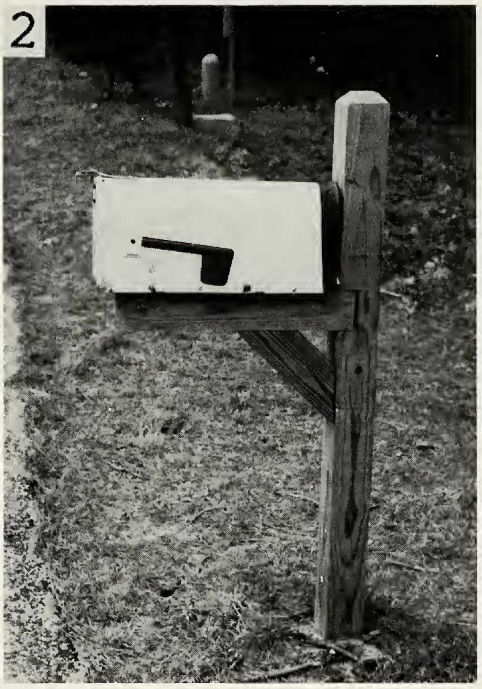
ABSTRACT. The data for species of spiders observed and collected for a period of eight years from a rural delivery mailbox route in Mashpee, Massachusetts is examined. We collected 1252 individuals, with 199 species represented. Some species were year-round residents of mailboxes while others appeared only during limited periods of time. Species typically found in the foliage of coniferous trees and on the trunks of pines and oaks dominated the collections, with lesser numbers from other types of habitats. The species observed are divided into categories depending upon their consistency in terms of time of occurrence and number. Species that occurred only rarely tended to be different from year to year.

Arachnologists have long been aware that the structure of the habitat, along with seasonal and other environmental factors, plays a dominant role in determining where spiders are to be found (Stratton, Uetz & Dillery 1978; Hatley & MacMahon 1980; Bultman & Uetz 1983; Gunnarsson 1983, 1992; Greenstone 1984; Rypstra 1986; Moring & Stewart 1994; Reichert & Gillespie 1986; Rushton 1991; Sundberg & Gunnarsson 1994).

Defining the niche of any organism is a daunting task. Each species has a complex set of interacting biotic and abiotic requirements within which it survives (Hutchinson 1957). In the case of spiders it is difficult to define their individual niche requirements based only on the specific habitat within which they have been collected. A surprising number of species collected in well defined habitats are clearly not typical occupants of the habitat and may be considered rare or accidental. When the sampling procedure is based on a set of quadrats, a species that occurs in only one quadrat, whatever the number of individuals, is referred to as a 'unique' species (*cf.* Heltsche & Forrester 1984). The term 'unique' is neutral in that it does not presume that the species is necessarily rare or accidental within the habitat. Unique species make up a large percentage of the spider species collected in many habitats, varying from 25–50% of the total number of species collected (Edwards 1993). Spiders are vagile and accordingly tend to confuse the issue when one is attempting to describe a typical species assemblage for any particular habitat. Some insight may be gained into the nature of unique species, the niche-spatial requirements of spider species and by the species assemblages observed from an examination of the data obtained collecting spiders from an artificial habitat; in this case the rural delivery mailboxes in Mashpee, Barnstable County, Massachusetts.

METHODS

Typical mailboxes and their settings are shown in Figs. 1, 2. The standard box is made of galvanized sheet metal, usually 16.5 cm wide, 21.5 cm high and 48 cm long and has a rounded top (Fig. 1). The mailbox is often painted black or variously decorated by the owner. The box is supported by a pipe or stout post, *circa* 8 cm in cross section upon which it is directly seated or from which it is cantilevered and may have additional oblique supports at the bottom (Fig. 2). On sunny days these boxes may get very warm. Attendance to 350–400 such boxes, involving some 40 km of travel daily, Monday–Saturday, comprises the average route. The mailman, Eric Edwards, is familiar with the local species and collects those spiders not previously collected, or that had not been collected in any particular month. Time constraints and other factors make it impossible to observe or collect spiders from these boxes systematically. The mailbox is described and the results of the initial three years of data collection are provided in Edwards & Edwards (1991). As of July 1995, eight years of collecting and observation have been completed and 199 species (1252 individuals) of spiders collected. The



Figures 1, 2.—Photographs of rural delivery mailboxes. 1, Box fastened to top of post, front end with door open. The projecting handle at top of door and handle lock on top of box. Note space between bottom of door and box; 2, Cantilevered mailbox. Notice that post projects above the mailbox and the oblique support beneath.

mailboxes are usually situated a short distance away from vegetation other than short grass or lawn. Occasionally there will be a simple, doorless box on a slender metal stake nearby for newspaper deliveries. These boxes were not sampled. The area has many ponds and bogs, some fields, and abundant lawns, with pitch pine (*Pinus rigida* Mich.), white pine (*Pinus strobus* L.), red cedar (*Juniperus virginianus* L.) and several species of oaks (red -*Quercus rubra* L.; scarlet -*Q. coccinea* Muenshh.; and white -*Q. alba* L.) dominating the patches of woods in the surrounding areas. A large variety of shrubs, both local species and horticultural varieties, are found nearby. The mailboxes offer a unique set of spatial options to the spiders that happen upon them. These options include the outer, smooth surface, approximately 3,670 cm^2, the dark interior of the box, the handle and door lock that extend up and out from the box when the door is closed, the outer bottom surface, and any space between the overlapping flange of the door and the box itself on the sides and top. The space between the bottom of the door and the box is fairly wide (±5 mm), and is used as passages by many species (Fig. 1). Other than spiders, prey in the form of ants and flies are frequently found on the box. Representative collections of species have been deposited in the United States National Museum.

As in the case of agroecosystems (Rypstra & Carter 1995), the mailboxes are newly colonized each year with a large number of species that have overwintered elsewhere. The niche-spatial options offered by the mailbox represent a consistent set of microhabitats within an artificial habitat that, in turn, exists within a complex array of natural habitats.

RESULTS AND DISCUSSION

Unique species.—Considering each month as a separate quadrat for the purposes of this study, 72 species (36%) of spiders collected from the mailboxes during the period June 1987–July 1995 classify as unique species (Table 1). Sixty-five of these were represented by single individuals, seven by two individuals. The two seasonal modes in the number of species, early summer and fall, are typical of the overall area. The unique species are roughly proportional to the total number of

Table 1.—Number of species collected in one month only during the period June 1987–July 1995. Collected from Mashpee, Massachusetts rural delivery mailboxes.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1987						4		2	1	1			8
1988						2				1			3
1989				2	3	6	5	1	3	2	3		25
1990	1				1	2		1					5
1991					2	1	3	1	2	1			10
1992			1			1	4					1	7
1993			1	3	1								5
1994			1			3	1		1	1			7
1995					1	1							2
Total	1	0	3	5	8	20	13	5	7	6	3	1	72

species found each month (Fig. 3), suggesting that ballooning accounts for many of these occurrences (Bishop & Riechert 1990). Over a long period of time one would expect the number of these species to diminish slowly as, by virtue of their vagility, individuals of all the species of the regional pool will eventually happen upon the mailbox. The regional pool of spiders in the Mashpee area is estimated to be approximately 500 species (Edwards 1993).

Residential species.—At least 39 species are found on the mailboxes much of the year and are referred to here as 'residential' species (Table 2). The boxes are disturbed to some degree on most mail days because of the large amounts of material gratuitously sent to 'Box Holder' or 'Resident Box RR04.' From time to time, large numbers of boxes are vandalized. In spite of this, many species establish more or less permanent positions with capture webs and/or retreats in or on the box (Edwards & Edwards 1991). For example, *Steatoda borealis* (Hentz 1850) is consistently found deep inside the box where it builds its web and deposits its egg sacs. In a natural setting this spider is found in recesses in the trunks of trees and logs, but can be common also under domestic refuse, such as piles of old lumber around houses. Similarly, *Pityohyphantes costatus* (Hentz 1850) maintains a sheet web near the front end at the top of the box where it is also less affected by the act of delivering or removing mail. Other species, for example *Philodromus vulgaris* (Hentz 1847), build retreats (within which egg sacs are deposited) along the inside edges of the door and box and search for prey outside. These species move in and out of the box freely through the space at the bottom and around any other open edges of the door. Three theridiid species, *Thymoites unimaculatus* (Emerton 1882), *Theridion murarium* Emerton 1882, and *Theridion lyricum* Walckenaer 1841, and the tetragnathid *Tetragnatha viridis* Walckenaer 1841, are consistently found on the upward and outward projecting handle and door lock of the box (Fig. 1). The theridiids maintain webbing here, apparently replacing it readily despite disturbance. *T. viridis* makes no obvious organized web and seems to behave more like a mimetid spider: its presence appears to discourage the close presence of other species. We have found *T. viridis* on pines and cedars both day and night, and in all cases also without obvious capture webs (orbs). *Uloborus glomosus* (Walckenaer 1841) was observed only on white boxes, and was one of only a very few species that construct-

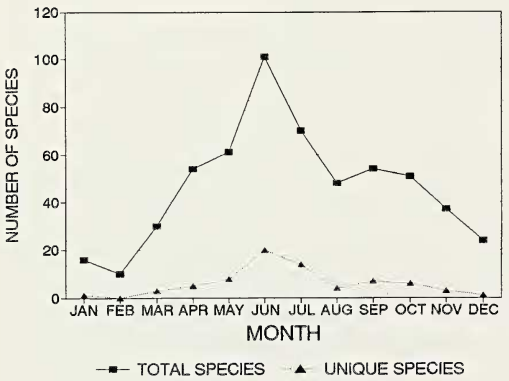


Figure 3.—The total number of species and number of unique species collected from Mashpee mailboxes, by month from June 1987–July 1995.

Table 2.—Mailbox species considered as residential. Based on collections and observations, June 1987–July 1995, Mashpee, Massachusetts. Arranged on basis of life cycle stages represented. Juv. = juvenile, Ad. = adult. The natural habitat in the Mashpee area for these species is indicated.

Species	Months	Stage	Habitat
Anyphaena celer (Hentz)	Mar–Oct	Juv. & Ad.	conifer
Hibana gracilis (Hentz)	Apr–Nov	Juv. & Ad.	conifer
Araneus bivittatus (Walckenaer)	Jan–Dec	Juv. & Ad.	conifer
Araneus gadus Levi	Mar–Dec	Juv. & Ad.	conifer
Araniella displicata (Hentz)	Apr–Dec	Juv. & Ad.	conifer
Eustala anastera (Walckenaer)	Jan–Dec	Juv. & Ad.	conifer
Grammonota pictilis (O.P.—Cambridge)	Mar–Nov	Juv. & Ad.	conifer
Pityohyphantes costatus (Hentz)	Jan–Dec	Juv. & Ad.	conifer
Mimetus notius Chamberlin	Feb–Nov	Juv. & Ad.	conifer
Oxyopes scalaris Hentz	Jan–Dec	Juv. & Ad.	conifer
Philodromus rufus Walckenaer	Mar–Dec	Juv. & Ad.	conifer
Metaphidippus exiguus (Banks)	May–Oct	Juv. & Ad.	conifer
Xysticus punctatus Keyserling	Mar–Dec	Juv. & Ad.	conifer
Theridion lyricum Walckenaer	Jan–Dec	Juv. & Ad.	conifer
Theridion murarium Emerton	Jan–Dec	Juv. & Ad.	conifer
Thymoites unimaculatus (Emerton)	May–Nov	Juv. & Ad.	conifer
Clubionoides excepta (C.L. Koch)	May–Sep	Juv. & Ad.	trunk
Philodromus vulgaris (Hentz)	Feb–Dec	Juv. & Ad.	trunk
Maevia vittata (Hentz)	Apr–Oct	Juv. & Ad.	trunk
Rhidippus audax (Hentz)	Mar–Nov	Juv. & Ad.	trunk
Platycryptus undata (DeGeer)	May–Sep	Juv. & Ad.	trunk
Coriarachne versicolor Keyserling	Mar–Sep	Juv. & Ad.	trunk
Steatoda borealis (Hentz)	Apr–Dec	Juv. & Ad.	trunk
Theridion lyricum Walckenaer	Jan–Dec	Juv. & Ad.	trunk
Euryopis limbata (Walckenaer)	Jun–Sep	Juv. & Ad.	trunk
Leucauge venusta (Walckenaer)	Apr–Nov	Juv. & Ad.	understory
Philodromus marxi Keyserling	Apr–Sep	Juv. & Ad.	understory
Tmarus angulatus (Walckenaer)	Apr–Nov	Juv. & Ad.	understory
Uloborus glomosus (Walckenaer)	May–Nov	Juv. & Ad.	understory
Metaphidippus protervus (Walckenaer)	Mar–Dec	Juv. & Ad.	field
Misumenops asperatus (Hentz)	Apr–Nov	Juv. & Ad.	field
Achaearanea tepidariorum (C.L. Koch)	Jan–Dec	Juv. & Ad.	house
Ceratinopsis atolma Emerton	Jan–Nov	Adults only	conifer
Ceratinopsis nigripalpis Emerton	Jan–Dec	Adults only	understory
Ceratinops lata (Emerton)	Apr–Sep	Adults only	trunk
Eperigone maculata (Banks)	Feb–Nov	Adults only	litter
Philodromus laticeps Keyserling	Mar–Nov	Juv. only	conifer
Tetragnatha versicolor Walckenaer	Jan–Dec	Juv. only	field
Tetragnatha viridis Walckenaer	Jan–Nov	Juv. only	conifer

ed well-defined orb webs on the box. *Phidippus audax* (Hentz 1845) is frequently encountered on the outside of the box and in retreats inside with egg sacs. One box had this species present throughout the sampling period.

Although egg sacs were frequently found, most could not be positively identified to species. However, it is clear that not all the species categorized as residential fully completed their life cycle on the box. Three species present much of the year, *Philodromus laticeps* Keyserling 1880, *Tetragnatha viridis* and *T. versicolor* Walckenaer 1841, leave the mailboxes as adults, presumably to mate and deposit egg sacs elsewhere. Both juveniles and adults of *Coriarachne versicolor* Keyserling 1880, (a darkly-colored crab spider, usually taken on pine tree trunks) and *Xysticus punctatus* Keyserling 1880, (a lightly-colored crab spider found in the foliage of conifers) are found on the boxes. These two species are found in the open in their natural habitat dur-

ing the day. Three erigonine species, *Ceratinops lata* (Emerton 1882), *Ceratinopsis atolma* Chamberlin 1925, and *Ceratinopsis nigripalpis* Emerton 1882, are present only as adults. The residential category as a whole is dominated by species most likely to be taken in coniferous foliage and on tree trunks (Table 2).

Seasonal species.—Thirty-five species, here categorized as 'seasonal' species, occurred consistently on the mailboxes for periods of 2–4 months, or occasionally more, during the year (Table 3). This group is dominated by species represented mostly, if not entirely, by adults. Species normally taken in the forest understory dominate. Some are warm weather species, others cold weather species. The population of *Micrathena sagittatta* (Walckenaer 1841) dramatically increased in recent years (1994–1995). Adults and a few late instars were encountered more frequently at this time, on the boxes and in webs anchored between the top edge of the box and the upper end of the supporting post (Fig. 2) or between the handle and the lower surface of the door. *Xysticus fraternus* Banks 1895, is most often found in leaf litter but shows up on boxes only as adults in June and

Table 3.—Species found seasonally on mailboxes. Arrayed by life cycle stages. Ad. = adult, Juv. = juvenile, Adults+, males+, and females+ indicates very few juveniles also found. Juv.+ indicates very few adults collected or observed. The natural habitat for these species in the Nashpee, Massachusetts area is indicated.

Species	Months	Stage	Habitat
Eris militaris (Hentz)	Apr–Jun	Juv. & Ad.	understory
Hentzia mitrata (Hentz)	May–Jun	Juv. & Ad.	understory
Admestina wheeleri (Peck. & Peck.)	May–Jun	Juv. & Ad.	trunk
Herpyllus ecclesiasticus Hentz	Jul–Oct	Juv. & Ad.	trunk
Metaphidippus insignis (Banks)	May–Jul	Juv. & Ad.	field
Salticus scenicus (L.)	Apr–Jul	Juv. & Ad.	field
Tutelina similis (Banks)	Jun–Sep	Juv. & Ad.	field
Anyphaena pectorosa L. Koch	Jun–Aug	Adults+	understory
Micrathena sagittata (Walckenaer)	Jun–Sep	Adults+	understory
Gladicosa pulchra (Keyserling)	Aug–Oct	Adults+	trunk
Hyposinga rubens (Hentz)	Jun–Jul	Adults+	trunk
Neoscona arabesca (Walckenaer)	Jul–Aug	Adults+	field
Centromerus latidens (Emerton)	Mar–May	Adults+	litter
Ceraticelus alticeps (Fox)	May–Jul	Ad. only	conifer
Theridion glaucescens Becker	Jun–Aug	Ad. only	conifer
Agelenopsis potteri (Blackwall)	Aug–Sep	Ad. only	understory
Argyrodes trigonum (Hentz)	Jul–Sep	Ad. only	understory
Origanates rostratus (Emerton)	Dec–Apr	Ad. only	understory
Sciastes truncatus (Emerton)	Oct–Mar	Ad. only	understory
Soulgas corticarius (Emerton)	Sep–Jan	Ad. only	trunk
Erigone autumnalis Emerton	Jan–Aug	Ad. only	field
Erigone dentigera (O.P.—Cambridge)	Jun–Jul	Ad. only	field
Xysticus fraternus Banks	Jun–Jul	Ad. only	litter
Robertus pumilus (Emerton)	Mar–Apr	Females+	litter
Agelenopsis pennsylvanicus (C.L.K.)	Aug–Oct	Females	understory
Trachelus tranquillus (Hentz)	Oct–Nov	Females	mailbox
Dictyna minuta Emerton	May–Jul	Males	conifer
Frontinella pyramitela (Walckenaer)	Mar–Nov	Males	conifer
Zyballus bettini Peckham	Jan–Sep	Males	field
Meriene clathrata (Sundevall)	Apr	Juv.+	litter
Steatoda americana (Emerton)	Apr–Sep	Juv.+	litter
Dipoena nigra (Emerton)	Jun–Jul	Juv.	trunk
Hentzia palmarum (Hentz)	Apr–Oct	Juv.	understory
Pisaurina mira (Walckenaer)	Aug–Oct	Juv.	understory
Trabeops aurantiaca (Emerton)	Mar–Jun	Juv.	litter

July. Two species of *Agelenopsis, pennsylvanicus* (C.L. Koch 1843) and *potteri* (Blackwall 1846), appear briefly in late summer and early fall as adult females and deposit egg sacs in the mailbox. This is consistent with their behavior in natural settings. As they mature they tend to build larger and higher funnel webs in the understory, and frequently deposit their egg sacs under loose bark or other such refugia. In one unusual circumstance, in a web shared by both a male and female *A. pennsylvanicus,* a female *Trachelus tranquillus* (Hentz 1847), had been captured. Adult females of *Trachelus tranquillus* consistently show up in the mailbox only in the fall. *Trabeops aurantiaca* (Emerton 1885) took refuge inside the box in late spring as preadult instars. At this time of the year they are taken high up on understory shrubbery, possibly as a prelude to ballooning: otherwise they tend to be found most commonly on the forest floor and in leaf litter. Several erigonine species of the genera *Erigone, Eperigone, Grammonota* and *Walckenaeria* can be abundant in lawns. Of these only adults of *Erigone autumnalis* (Emerton 1882) and *Erigone dentigera* (O.P.-Cambridge 1874) showed up regularly on the boxes. The adults of two other erigonine species, *Ceratinops lata* (Emerton 1882), and *Soulgas corticarius* (Emerton 1909) are found in the narrow space between the overlapping rim of the door and the box. They take shelter under shallow, shaded refuges on tree trunks such as those provided by lichens. Six of the seven seasonal species that included a range of instars (juveniles and adults) are salticids.

Ballooning.—The large number of random strands of silk observed at the uppermost part of the box, the handle, and the top of the post suggest that these positions were used as launching points for ballooning. However, no spiders were observed in the act of ballooning. This activity may account for the presence of some species, particularly those in the unique and unassigned categories.

Distribution trends.—There are clear trends in the numbers of species from the unique to residential categories (Table 4). Of the 199 species collected on the mailbox, 125 are represented by few records and/or sporadic occurrence and could not be assigned to either the residential or seasonal categories with any confidence (72 unique, 53 unassigned). The unique category was dominated by species commonly found in fields and leaf litter. Species from such habitats decreased in number sequentially to just a few in the residential category. Species only taken on mailboxes are particularly interesting since, so far, they still remain to be taken elsewhere in this area despite intensive collecting over many years. Some examples include *Ceraticelus bryantae* Kaston 1945, reported from Connecticut; *Marpissa wallacei* Barnes 1958, which has yet to be reported further north than Georgia, and *Disembolus sacerdotalis* Crosby & Bishop 1933, apparently a rare species known only from the holotype (Millidge 1981). Few understory and coniferous species occurred as unique species with the exception of the larger species of *Araneus. Araneus* probably found little support in the immediate vicinity of the box for constructing orbs. *Eustala anastera* (Walckenaer 1841), on the other hand, is found year round on the box, but without webbing.

Table 4.—Habitats where species collected from mailboxes are most likely to be found in the Mashpee, Massachusetts area, for each category used in text.

	Unique	Unassigned	Seasonal	Residential
Field	36	19	7	3
Leaf litter	13	10	6	1
Understory	5	15	11	5
Conifer	5	5	4	19
Tree trunk	3	1	6	10
Around house	3	2		1
Mailbox only	7	1	1	
Totals	72	53	35	39

Comments on source habitats.—The unassigned category is dominated by species usually found in fields and on understory foliage (Table 4). Understory species dominated the seasonal category. The residential category is made up largely of species (74%) typically found on two types of natural habitats, coniferous foliage and tree trunks. Thirty-nine (53%) of the 74 species in the seasonal and residental categories are taken on coniferous foliage and tree trunks. These last two habitat types are the principal sources of the consistently observed mailbox spiders.

Table 5 lists 104 species taken in coniferous foliage (pitch pine and red cedar) and on the

Table 5.—Percent of quadrats occupied by species in foliage of pitch pine and red cedar and on trunks of pitch pine and oaks. Study carried out on Cape Cod, Massachusetts, 1989 and 1990 (Edwards 1993). Arrayed as categorized for species taken from mailboxes, and within each category in order by those taken on coniferous foliage only, on both foliage and trunks, and on trunks only.

	Foliage		Trunk	
	Pine	Cedar	Pine	Oak
No. of species	67	65	42	44
No. of quadrats	40	44	40	41
No. of unique species	23	15	19	22
Species not taken on mailbox				
Cesonia bilineata (Hentz)		2.3		
Ceraticelus pygmaeus (Emerton)	2.5			
Misumenops formosipes (Walckenaer)	2.5			
Thanatus formicinus (Olivier)	2.5			
Walckenaeria brevicornis (Emerton)	2.5			
Philodromus pernix Blackwall		4.5		
Neriene radiata (Walckenaer)		4.5		
Phoroncidia americana (Emerton)	2.5	2.3		
Steatoda albomaculata (DeGeer)	2.5	2.3		
Grammonota maculata Banks	5.0			
Grammonota ornata (O.P.—Cambridge)	5.0			
Litopyllus temporarius Chamberlin	2.5		2.5	2.4
Achaearanea globosum (Hentz)	10.0	34.1		2.4
Sergiolus variegatus (Hentz)				2.4
Araneus pratensis (Emerton)			2.5	
Species categorized as unique on mailbox				
Araneus diadematus Clerck	2.5			
Dipoena buccalis Keyserling	2.5			
Araneus miniatus (Walckenaer)	2.5	15.9	2.5	
Theridion frondeum Hentz	2.5	4.6	2.5	12.2
Theridion crispulum Simon	12.5	25.0	2.5	4.9
Mangora gibberosa (Hentz)				2.4
Strotarchus picatorius (Hentz)				31.7
Drapetisca alteranda Chamberlin			5.0	70.7
Species categorized as unassigned on mailbox				
Ceraticelus similus (Banks)		2.3		
Ero leonina (Hentz)		2.3		
Philodromus placidus Banks		2.3		
Mangora placida (Hentz)	2.5	2.3		
Phidippus whitmani (Peckham)	2.5	2.3		
Gonatium crassipalpum Bryant		6.8		
Philodromus exilis Banks	2.5	6.8		
Theridion differens Emerton	5.0	2.3		
Hypselistes florens (O.P.—Cambridge)	5.0	4.5		
Cyclosa conica (Pallas)	10.0			
Araneus marmoreus Clerck		11.4		
Mangora maculata (Keyserling)		11.4		
Enoplognatha ovata (Clerck)	5.0	6.8		
Philodromus imbecillus Keyserling	12.5	2.3		
Eris pineus (Kaston)	22.5			
Araneus partitus (Walckenaer)	2.5	2.3		2.4
Theridion alabamense Gertsch & Archer	5.0	13.6	25.0	36.6
Nodocion floridanus (Banks)				2.4
Sylaceus pallidus (Emerton)				2.4
Tetragnatha laboriosa Hentz				2.4

Table 5.—Continued.

	Foliage		Trunk	
	Pine	Cedar	Pine	Oak
Tutelina elegans (Hentz)			2.5	
Mimetus puritanus Chamberlin			2.5	
Lepthyphantes sabulosa (Keyserling)			2.5	
Tutelina similus (Banks)			5.0	
Pulex habrocestum (Hentz)			2.5	17.1
Philodromus validus (Gertsch)			60.0	2.4
Species categorized as seasonal on mailbox				
Dictyna minuta Emerton	5.0			
Neoscona arabesca (Walckenaer)	5.0			
Theridion glaucescens Becker	7.5			
Eris militaris (Hentz)	5.0	9.1		
Pisaurina mira (Walckenaer)	12.5	4.5		
Zygoballus bettini Peckham		2.3		2.4
Centromerus latidens (Emerton)		4.5	2.5	2.4
Anyphaena pectorosa L. Koch	5.0	13.6	2.5	2.4
Argyrodes trigonum (Hentz)	20.0	13.6		7.3
Gladicosa pulchra (Keyserling)	2.5		15.0	22.0
Frontinella pyramitela (Walckenaer)	37.5	36.4	7.5	2.4
Hypsosinga rubens (Hentz)		2.3	57.5	39.0
Dipoena nigra (Emerton)	30.0	9.1	45.0	39.0
Ceraticelus alticeps (Fox)	82.5	59.1	45.0	9.8
Agelenopsis pennsylvanicus (C.L. Koch)				2.4
Hentzia mitrata (Hentz)				2.4
Hentzia palmarum (Hentz)				2.4
Admestina wheeleri Peckham & Peckham			15.0	12.2
Herpyllus ecclesiasticus Hentz			27.5	7.3
Species categorized as residential on mailbox				
Ceratinopsis nigripalpis Emerton		2.3		
Eperigone maculata (Banks)		2.3		
Tetragnatha versicolor Walckenaer		2.3		
Maevia vittata (Hentz)	2.5			
Ceratinopsis atolma Chamberlin	2.5	4.5		
Philodromus laticeps Keyserling	17.5			
Araniella displicata (Hentz)	2.5	15.9		
Oxyopes scalaris Hentz	20.0	15.9		
Tetragnatha viridis Walckenaer	15.0	29.5		
Philodromus rufus Walckenaer		56.8		
Mimetus notius Chamberlin	25.0	22.7		
Anyphaena celer (Hentz)	25.0	47.7		
Xysticus punctatus Keyserling	55.0	40.9		
Misumenops asperatus (Hentz)	2.5	4.5	2.5	
Tmarus angulatus (Walckenaer)	2.5	6.8	5.0	
Uloborus glomosus (Walckenaer)	10.0	4.5	2.5	2.4
Pityohyphantes costatus (Hentz)	5.0	13.6	2.5	
Araneus gadus Levi	12.5	11.4		2.4
Soulgas corticarius (Emerton)	2.5		17.5	9.8
Philodromus marxi Keyserling	10.0	18.2		2.4
Metaphidippus protervus (Walckenaer)	10.0	18.2	2.5	
Euryopis limbata (Walckenaer)	5.0	4.5	5.0	22.0
Leucauge venusta (Walckenaer)	12.5	11.4	2.5	12.2
Hibana gracilis (Hentz)	40.0	4.5	2.5	
Philodromus vulgaris (Hentz)	22.5	18.2	5.0	4.9
Coriarachne versicolor Keyserling	2.5	2.3	50.0	4.9

Table 5.—Continued.

	Foliage		Trunk	
	Pine	Cedar	Pine	Oak
Thymoites unimaculatum (Emerton)	17.5	25.0	20.0	2.4
Araneus bivittatus (Walckenaer)	32.5	38.6	5.0	
Eustala anastera (Walckenaer)	27.5	34.1	10.0	22.0
Metaphidippus exiguus (Banks)	50.0	50.0		2.4
Theridion murarium Emerton	72.5	47.7	2.5	2.4
Grammonota pictilis (O.P.—Cambridge)	52.5	81.8	2.5	
Clubionoides excepta (L. Koch)	25.0	27.3	55.0	43.9
Theridion lyricum Walckenaer	32.5	56.8	50.0	75.6
Playcryptus undata (DeGeer)			15.0	
Ceratinops lata (Emerton)			15.0	34.1

trunks of pitch pine and of oaks (red, scarlet and white). For each quadrat in these habitats, 1 m^2 was sampled by beating (coniferous foliage); brushing (oak trunks) and bark removal (pitch pine). For further information on collection methods used and a description of these habitats, see Edwards (1993).

Of the 104 species taken, 15 (14%) were not collected on the mailboxes; and, of these, 11 occurred in coniferous foliage only (Table 6). With the exception of *Achaearanea globosum* (Hentz 1850), these species were represented only in a small percentage of quadrats, suggesting that they occurred accidentally or were uncommon. Only eight (11%) of the 72 unique species found on the mailboxes occurred in either of the principal source habitats, with no other particular outside source suggested (Table 6). Categorized as a unique species on the mailbox, *Strotarchus piscatorius* (Hentz 1847) was taken only on the trunks of oaks where adult females with egg sacs were found in shaded, moist crevices. A comparable niche option was not offered by the mailbox.

Table 6.—Distribution of mailbox species taken from trunks only, from coniferous foliage only, and from both foliage and trunks. T = trunk, F = foliage, TF = both trunk and foliage, *n* = total number of species.

Mailbox category	T	F	TF	*n*
Residential	2	13	21	36
Seasonal	5	4	10	19
Unassigned	9	15	2	26
Unique	3	2	3	8
Not on mailbox	2	11	2	15
Total	20	45	39	104

The majority of the 26 species in the unassigned category were also not abundant in any of the four natural habitats. Fifteen species were found in foliage habitats only, nine solely from trunk habitats, and just two on both types of habitats (Table 6), suggesting that some species with more restricted niches tend not to be attracted to the mailbox. Eight unassigned species (31%) were found in more than 10% of the quadrats in natural habitats (Table 5), although most were confined to either foliage or trunks with the exception of *Theridion alabamense* Gertsch & Archer 1942 (25.0% of pine trunks and 36.6% of oak trunks). Particularly interesting are two species that are taken abundantly and only on the trunks of pine and smooth barked trues such as oak and beech. *Drapetisca alteranda* Chamberlin 1909 and *Philodromus validus* (Gertsch 1993) have been taken on mailboxes once and twice respectively. *D. alteranda* is one of the most abundant species collected from the relatively smooth barked oak trees (70.7% of quadrats). It produces a flimsy sheet web, vaguely circular in outline. The webbing tends to be supported by minor projections of the bark, otherwise it is essentially flat. The spider sits anchored in a depression, usually at the periphery of the web. As a consequence of its being anchored, when using a stiff brush as a sampling tool one often collects only the cephalothorax. It is unclear how this spider fixes itself to the bark. The mailbox did not offer a comparable setting. *Philodromus val-*

idus was the most common spider taken on pitch pine trunks, 60.0% of quadrats. It appears to prefer the rough-barked pitch pine where it takes refuge during the day in the many shallow leaf-like crevices of the bark. Again, the mailbox did not provide a comparable spatial niche. Here, again, it appears that specialization, e.g., trunks as opposed to foliage, tends to limit occurrence on the mailbox.

Of the 35 species in the mailbox seasonal category, 19 (68%) were taken in the four principal source habitats, ten of which were taken both in coniferous foliage and on pine and oak trunks (Table 6). It should be noted that the seasonal category (Table 5) includes many more abundant species than those included in the previous categories. However, one notable exception is the more abundant spider on coniferous foliage and pitch pine trunks, *Ceraticelus alticeps* (Fox 1891), found in 56.0–82.5% of quadrats. This small erigonine species occurs as well in the foliage of deciduous trees. It has been taken on mailboxes as adults only, not abundantly, suggesting a preference for truly arboreal situations. In contrast, juveniles and adults of a slightly larger erigonine species, *Grammonota pictilis* (O.P.-Cambridge 1875) also abundant in coniferous foliage, are to be found on the mailbox much of the year and categorized as residential. *Agelenopsis pennsylvanicus* and *A. potteri* females, as noted earlier, consistently appear inside the mailboxes in late summer, where they construct sheet webs both in and out of the box, and deposit their egg sacs. The collecting method used (brushing) on oak trunks is not an effective method for collecting these two species or any other spider that tends to hide underneath large pieces of dead bark. Aside from the spiders that built webs on the handle and the salticids, many of the erigonine species were found in retreats in spaces between the door flange and sides of the box or just inside the box where the floor meets the wall. Eight species (42%) were present in 10% or more of the quadrats of the natural habitats.

Most of the species in the residential category are represented in these natural habitats by relatively abundant spiders. Twenty-one were to be found in both foliage and trunk habitats, and 13 in coniferous foliage only, suggesting that the former group were more eclectic in selecting a "home" or prone to moving about. Twenty-four (83%) of the 36 residential species were taken in more than 10% of the quadrats in one or more of the natural habitats.

It will be noted that 72 unique species were collected from the mailboxes (36% of total), and approximately the same percentage, 34% (23 unique species), from pitch pine foliage; and somewhat less, 23% (15 unique species), from red cedar foliage. On the other hand, 45% or 19 species were unique in the pitch pine trunk samples and 50% (22 unique species) in oak trunk samples, suggesting that a greater proportion of species were using the trunk as an avenue to other habitats. The percentage of species in 10% or more of the natural habitats (Table 5) that occurred in the mailbox categories increased sequentially; in the unassigned category, 31%; in the seasonal category, 42%; and in the residential category, 83%.

SUMMARY

With the exception of the few species that deposited eggs and were subsequently observed as both juveniles and adults, none of the mailbox observations shed direct light on the manner in which various species arrived at the mailbox each year. Mailboxes are relatively isolated (see Fig. 2) and it is tempting to suggest that the presence of many species resulted from ballooning. Studies of spiders in agroecosystems, e.g., Bishop & Riechert 1990, Rypstra & Carter 1995 and Young & Edwards 1990, strongly suggest that ballooning plays a significant role in the annual repopulation of new habitats. Pitfall trap studies in various local habitats capture a surprising variety of species, typically dominated by older instars and adults. We suspect that the residential category (Table 2), including as it does species with relatively large numbers of early instars as well as adults later in the year, may be dominated by species that arrive initially as a consequence of ballooning, and that the membership of the seasonal category (Table 3) is dominated by adults of species that entered "on foot".

This report examined the pattern of niche-spatial and temporal variations observed in the spiders present on mailboxes, and is 'macroecological' in nature (*cf.* Brown 1995). It was not feasible, given stringent time limita-

tions and other factors, for the mailman to systematically collect and make observations. As a consequence, it is not possible to treat the mailbox data other than semiquantitatively. Nonetheless, these observations on a totally artificial habitat help to bring out emergent characteristics in spider niche selection and species assemblages. The number of unique and accidental species that parade through time and remain only briefly, initially suggests that colonization of the mailbox is almost a random process. However, the patterns observed are not as kaleidoscopic as it might first appear. There is a core assemblage on the mailbox represented by those species categorized as residential. This assemblage is periodically and consistently (and apparently successfully), challenged by other species at different and for shorter periods of time. This group in general is categorized as seasonal. In addition, there are yet other species, those in the unique and unassigned categories, which appear sporadically in time and in small numbers, and are judged to be engaged in attempts to balloon or that are unsuccessful in gaining a foothold. To a certain extent, the data for the source habitats (Table 5) suggests that comparable interactions may be involved.

ACKNOWLEDGMENTS

For assisting in species identifications, we wish to thank Vincent D. Roth, (Portal, Arizona); James H. Redner (Biosystematics Research Institute, Ottawa, Canada); and G.B. Edwards (Florida State Collections of Arthropods, Gainesville, Florida). We appreciated the many helpful suggestions made by the individuals who reviewed the manuscript for the journal. We are indebted to John B. Pearce (Northeast Fisheries Center, Woods Hole) for his comments and suggestions on the revised manuscript.

LITERATURE CITED

Bishop, L. & S.E. Riechert. 1990. Spider colonization of agroecosystems: mode and source. Environ. Entomol., 19:1738–1745.

Brown, J.H. 1995. Macroecology. Univ. Chicago Press, Chicago.

Bultman, T.L. & G.W. Uetz. 1983. Abundance and community structure of forest floor spiders following litter manipulation. Oecologia, 55:34–41.

Edwards, R.L. & E.H. Edwards. 1991. Spiders (Araneae) associated with rural delivery mailboxes, Mashpee, Massachusetts. Entomol. News, 102:137–149.

Edwards, R.L. 1993. Can the species richness of spiders be determined? Psyche, 100:185–208.

Greenstone, M.H. 1984. Determinants of web spider species diversity; vegetation structural diversity vs. prey availability. Oecologia, 62:299–304.

Gunnarsson, R. 1983. Winter mortality of spruce living spiders; effects of spider interactions and bird predation. Oikos, 40:226–233.

Gunnarsson, R. 1992. Fractal dimension of plants and body size distribution of spiders. Funct. Ecol., 6:636–641.

Hatley, C.L. & J.A. MacMahon. 1980. Spider community organization; seasonal variation and the role of vegetation architecture. Environ. Entomol., 9:632–639.

Heltsche, J.F. & N.E. Forrester. 1983. Estimating species richness using the jackknife procedure. Biometrics, 39:1–11.

Hutchinson, G.E. 1957. Concluding remarks. Cold Spring Harbor Symp. Quant. Biol., 22:415–27.

Millidge, A.F. 1981. The erigonine spiders of North America. Part 4. The genus *Disembolus* Chamberlin and Ivie (Araneae: Linyphiidae). J. Arachnol., 9:259–284.

Moring, J.B. & K.W. Stewart. 1994. Habitat partitioning by the wolf spider (Araneae, Lycosidae) guild in streamside and riparian vegetation zones of the Conejos River, Colorado. J. Aranchnol., 22:205–217.

Riechert, S.E. & R.G. Gillespie. 1986. Habitat choice and utilization in web building spiders. Pp. 23–48. *In,* Spiders: Webs, Behavior and Evolution. (W.A. Shear, ed.). Stanford Univ. Press, Stanford.

Rushton, S.P. 1991. A discriminant analysis and logistic regression approach to the analysis of *Walckenaeria* habitat characteristics in grassland (Araneae: Linyphiidae). Bull. British Arachnol. Soc., 8:201–208.

Rypstra, A.L. 1986. Web spiders in temperate and tropical forests; relative abundance and environmental correlates. American Midl. Nat., 115:42–51.

Rypstra, A.L. & P.E. Carter. 1995. The web-spider community of soybean agroecosystems in southwestern Ohio. J. Arachnol., 23:135–144.

Stratton, G.E., G.W. Uetz & D.G. Dillery. 1978. A comparison of the spiders of three coniferous tree species. J. Arachnol., 6:219–226.

Sundberg, I. & R. Gunnarsson. 1994. Spider abundance in relation to needle density in spruce. J. Arachnol., 22:190–194.

Young, O.P. & G.B. Edwards. 1990. Spiders in United States field crops and their potential effects on crop pests. J. Arachnol., 18:1–27.

Manuscript received 31 August 1995, revised 15 May 1996.